NetLander: The Seismic Investigation of the Interior of Mars

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Despite 30 years of intensive observations of Mars, the structure of its interior is still largely unknown. Gravity field modeling, measurements of rotational parameters, and geochemical analyses of Mars meteorites have served to bound possible models, but have produced few unambiguous results. In order to make a significant leap in our understanding of the interior of Mars, a seismic investigation is required. This has been one of the motivations for the development of the NetLander mission to Mars to be launched in 2007. This mission consists of a set of four small, low-mass landers, each of which will carry, among other instruments, an ultra-broad-band seismometer system which will operate on the surface for at least one Martian year. Despite severe constraints on mass, volume and power, the seismometers will have a sensitivity comparable to the best terrestrial seismometers (4-5 orders of magnitude better than the Viking instrument) over a wide frequency band, from DC to 50 Hz. The lander itself is designed to allow direct coupling of the seismometer to the ground, while providing protection from the wind and temperature extremes. This global seismic network will record the full range of seismic and gravity signals, from the body waves, surface waves and free oscillations generated by quakes induced by tectonics (driven by the thermoelastic contraction of the lithosphere and convective stresses), to meteoroid impacts and possible volcanic tremors, to the continuous excitation of planetary normal modes (by turbulence in the atmosphere) and tidal perturbations induced by Phobos. The comprehensive analysis of these seismic signals will enable us to determine the seismicity of the planet and the present-day meteoroid flux, and to constrain the thickness of the Martian crust, the composition and structure of Mars' mantle, including its phase transitions, as well as the state and size of the Martian core.